



**MISSOURI DEPARTMENT OF TRANSPORTATION  
MATERIALS ENGINEERING  
JEFFERSON CITY, MISSOURI**

**TEST METHOD  
MoDOT T55  
DETERMINATION OF CALCIUM, MAGNESIUM  
AND POTASSIUM IN SOILS**

**1.0 Scope.** This method describes a procedure for determining the pounds per acre of exchangeable calcium, magnesium and potassium in soils by atomic absorption spectrophotometry.

**2.0 Reagents and Apparatus.**

**2.1** An Atomic Absorption Spectrophotometer.

**2.2** Acetic Acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ), 95.5%, 1.05 specific gravity.

**2.3** Ammonium Hydroxide ( $\text{NH}_4\text{OH}$ ), 0.90 specific gravity.

**2.4** Hydrochloric Acid ( $\text{HCl}$ ), 1.42 specific gravity.

**2.5** Lanthanum Oxide ( $\text{La}_2\text{O}_3$ ), low calcium grade.

**2.6** Calcium Carbonate ( $\text{CaCO}_3$ ), primary standard grade, dried at 105-110°C for several hours prior to use.

**2.7** Potassium Chloride ( $\text{KCl}$ ), reagent grade, dried at 105-110°C for several hours prior to use.

**2.8** 1000 ppm Magnesium Stock Solution. This solution can be purchased from a number of sources, or it can be prepared in the laboratory from a suitable pure magnesium salt.

**3.0 Preparation of Extracting Solution (1N  $\text{NH}_4\text{OAc}$  @ pH 7.0).** Pour 58 mL of acetic acid into approximately 500 mL of distilled water. Add 70 mL  $\text{NH}_4\text{OH}$  and mix. Dilute to approximately 950 mL and cool. Adjust the pH to  $7.0 \pm 0.05$  with acetic acid or  $\text{NH}_4\text{OH}$ . Dilute to 1000 mL with distilled water.

**4.0 Preparation of Standard Solutions.**



**4.1 Lanthanum Stock Solution (10% La):** Weigh 117.28 g of  $\text{La}_2\text{O}_3$  into a 600-mL beaker and add 400 mL distilled water. While stirring, slowly add 500 mL HCl. Stir until solution is complete. Cool, transfer to a 1000-mL volumetric flask, and dilute to volume.

**4.2 Ca, Mg and K Standard Solution:** Weigh 0.5619 g dried  $\text{CaCO}_3$  into a 500-mL volumetric flask, dissolve in a minimum amount of HCl and add 0.0286 g dried KCl. Pipette a 25-mL aliquot of 1000 ppm Mg stock solution into flask and dilute to volume with distilled water. Pipette a 2-mL aliquot of this stock solution into a 100-mL volumetric flask. Add a 2-mL aliquot of 1N  $\text{NH}_4\text{OAc}$  extracting solution, a 2-mL aliquot of 10% La solution, and dilute to volume with distilled water. This solution is 9.0 ppm Ca (equivalent to 9000 lbs./acre Ca), 1.0 ppm Mg (equivalent to 1000 lbs./acre Mg), and 0.60 ppm K (equivalent to 600 lbs./acre K).

Note: If necessary, the range for Ca, Mg and K can be extended by preparation of a second standard prepared as follows:

Pipette a 4-mL aliquot of the Ca, Mg and K stock solution into a 100-mL volumetric flask, adding a 2-mL aliquot of 1N  $\text{NH}_4\text{OAc}$  extracting solution, a 2-mL aliquot of 10% La solution and diluting to volume with distilled water. This solution is 18.0 ppm Ca (equivalent to 18,000 lbs./acre Ca), 2.0 ppm Mg (equivalent to 2000 lbs./acre Mg), and 1.20 ppm K (equivalent to 1200 lbs./acre K).

**4.3 Blank Solution:** Pipette a 2-mL aliquot of 1N  $\text{NH}_4\text{OAc}$  extracting solution and a 2-mL aliquot of 10% La solution into a 100-mL volumetric flask and dilute to volume with distilled water.

**5.0 Procedure.** Place 1 g of soil into a 20-mL scintillation vial or other suitable container. Add 10 mL of extracting solution and shake for 5 minutes. Filter on Whatman #2 paper or equivalent. Pipette a 2-mL aliquot of the filtrate into a 100-mL volumetric flask, add a 2-mL aliquot of 10% La solution and dilute to volume with distilled water.

Calibrate the instrument using the Blank Solution and the Ca, Mg or K Standard Solutions, then determine the concentration of the Sample Solution.

**6.0 Calculations.** The method of calculating the lbs./acre of Ca, Mg and K will vary according to the make and model of instrument used.

Report the results to the nearest lb./acre as follows:

Pounds per Acre Calcium (Ca)  
Pounds per Acre Magnesium (Mg)  
Pounds per Acre Potassium (K)

